WATER POWER ACT LICENCES

SEVEN SISTERS GENERATING STATION SHORT TERM LICENCE EXTENSION APPLICATION

SUPPORTING DOCUMENTATION

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HYDRAULIC OPERATIONS DEPARTMENT
POWER SALES & OPERATIONS DIVISION
POWER SUPPLY

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APEGM
Certificate of Authorization
Manitoba Hydro
No. 38 Date: 2010 06 30

1.0 INTRODUCTION

This report is provided at the request of Manitoba Water Stewardship to provide additional information in support of a short term extension licence application. Manitoba Hydro requested this extension licence on February 04, 2010 in accordance with Section 92 of The Water Power Regulation, Manitoba Regulation 25/88R of The Water Power Act.

Manitoba Hydro operates the Seven Sisters Generating Station in accordance with the Final Licence for the Development of Water Power at the Seven Sisters Falls Site on the Winnipeg River. This licence was issued in accordance with the provisions of The Water Power Act on June 3, 1966 following completion of the second stage of this development. The licence was issued for a term of 50 years to be computed from January 1, 1932.

Manitoba Hydro submitted the application to renew the Final Licence on January 19, 1978. Major rehabilitation of the north non-overflow dam and spillway brought about delays in renewing the Final Licence. With the completion of this work and recent staffing improvements by both Manitoba Hydro and Manitoba Water Stewardship, there is a renewed focus on issuing a renewal of the Final Licence. Manitoba Hydro and Manitoba Water Stewardship are currently working through a process which will inform the Provincial Department's decision making process on issuing a renewal of the Final Licence.

2.0 PROJECT COMPONENTS

2.1 Seven Sisters Generating Station

The Seven Sisters Generating Station is located approximately 90 km (60 miles) northeast of the City of Winnipeg, and approximately 72 km (45 miles) upstream of Lake Winnipeg, as shown in Figure 1. Figure 2 is an overall site map that shows the layout of the major project components. Photograph 1 shows the Seven Sisters Generating Station powerhouse and spillway.

The Seven Sisters Generating Station consists of a powerhouse, spillway and dykes and has a name plate capacity of 180 MW (242,160 hp). The station was developed in two stages. The first stage was completed in 1931 and involved construction of three units. The second stage was completed in 1952, following World War II and involved construction of the additional three units.

The station components include a six unit powerhouse, a two bay gated sluiceway dividing a 27 bay spillway into two sections, two non overflow dams, and north and south dykes. The dykes extend for 9.6 km (5.6 miles) upstream on the Winnipeg River's north shore and 7.2 km (4.5 miles) upstream on the south shore. The dam and the dykes impound Natalie Lake. Figures 3, 4, and 5 show

general arrangements of concrete and earth structures. Table 1 summarizes major characteristics of the station.

Table 1: Seven Sisters G.S. Major Characteristics

Construction Period	1929 to 1952 (two-stages)
Capability	180 MW (242,160 hp)
Average Annual Generation	990 million kW-h
Waterfall Drop (head)	18.3 m (60.0 ft)
Maximum Licence Forebay Elevation	274.17 m (899.5 ft)
Maximum Operating Forebay Elevation (MOFE)	274.17 m (899.5 ft)
Available Freeboard @ MOFE - Conc. Structures	1.8 m (6.0 ft) *without wind or wave effects
Available Freeboard @ MOFE - Earth Structures	2.0 m (6.7 ft) *without wind or wave effects

Table 2 summarizes major characteristics of the Seven Sisters powerhouse, spillway, sluiceway, non-overflow dams and dykes.

Table 2: Seven Sisters G.S. Component Characteristics

Powerhouse	Number of Units	6
	Length	128.2 m (420.5 ft)
	Deck Elevation	276.0 m (905.5 ft)
	Discharge Capability (at full gate)	1,040 m^3/s (36,700 ft^3/s)
	Power Production Unit 1 Unit 2 Unit 3 Unit 4 Unit 5 Unit 6	 42,000 horsepower* 41,260 horsepower* 40,900 horsepower* 43,000 horsepower* 37,500 horsepower 37,500 horsepower
Spillway	Number of Bays	27 bays
	Length	225.0 m (738.2 ft)
	Deck Elevation	276.0 m (905.5 ft)
	Discharge Capability (at maximum operating forebay elevation)	3,100 m^3/s (109,600 ft^3/s)
Sluiceway	Number of Bays	2 bays
	Length	26.5 m (87.0 ft)
	Discharge Capability (at maximum operating forebay elevation)	920 m^3/s (32,500 ft^3/s)
North Non-Overflow Dam	Length	45.8 m (135.0 ft)
	Deck Elevation	276.0 m (905.5 ft)
South Non-Overflow Dam	Length	96.6 m (317.0 ft)
	Deck Elevation	276.0 m (905.5 ft)
North Dyke	Length	5.6 km (3.5 miles)
	Design Crest Elevation	276.2 m (906.2 ft)
South Dyke	Length	7.2 km (4.5 miles)
	Design Crest Elevation	276.2 m (906.2 ft)

* Units 1 to 4 were refurbished with increased unit output.

2.2 Pinawa Control Dam

Pinawa Control Dam is a rockfill structure located approximately 12 km (7.5 miles) upstream of the Seven Sisters Generating Station. The rockfill dam, as shown in Photograph 2, was constructed on top of the old control structure used to divert water from the Winnipeg River to the Pinawa Channel and the old Pinawa Generating Station. Following the increase in Seven Sisters capacity, the Pinawa Generating Station was abandoned in 1951. The control dam was then built to contain the flow of the Winnipeg River and direct the flow to Seven Sisters while maintaining a nominal flow through the Pinawa Channel. Flow in the Pinawa Channel is comprised primarily of seepage through the dam which generally varies with the level of the Winnipeg River. Manitoba Hydro is currently designing a replacement structure for the Pinawa Control Dam. Construction could begin as early as fall 2010 pending regulatory approvals.

3.0 WATER POWER LICENSING REQUIREMENTS

3.1 Licence Terms

Condition #2 of the Final Licence stipulates that:

> *"The undertaking authorized to be maintained and operated by the Licensee under this Final License shall comprise the following: a powerhouse with six main hydro-electric generators, having a capacity of 225,000 horsepower…."*

The initial capacity of each of the six units was 37,500 horsepower. Units 1 to 4 were refurbished between 1992 and 1998 with increased capacity to 42,000 horsepower (Unit 1, 1993), 41,260 horsepower (Unit 2, 1992), 40,900 horsepower (Unit 3, 1994) and 43,000 horsepower (Unit 4, 1998). A renewal of the Final Licence would include the new generating station capacity of 242,160 horsepower. The remaining original units (Units 5 and 6) are candidates for future refurbishment which would further increase the plant capacity. No timeframe for this work has been determined.

Condition #4 of the Final Licence stipulates that:

> *"The Licensee shall not raise the headwater of the development to an elevation higher than 899.5 feet above mean sea level, Canadian Geodetic Datum 1929 Adjustment, provided, however, that with the consent of the Licensee of the next development upstream, namely, Slave Falls Generating Station, and with the prior written approval of the Director, the Licensee may raise and maintain the headwater elevation in accordance with Section 72 of the Regulations."*

Manitoba Hydro operates the Seven Sisters Generating Station so that the forebay water level does not exceed 899.5 feet.

3.2 Licence Area

The licence area extends from approximately 2.5 km (1.6 miles) downstream of the Seven Sisters Generating Station upstream to just past Otter Falls and approximately 1.6 km (1.0 mile) downstream of the Pinawa Control Dam. During the Final Licence renewal, Manitoba Hydro intends to apply to expand the licence area to include land between the Pinawa Control Dam and the old Pinawa Generating Station. The licence area is shown in Manitoba Water Stewardship file number 21-7-1016. New severance line drawings that reflect all approved changes to the licence area and also show the proposed expansion will be submitted as part of the Final Licence renewal process.

4.0 MONITORING PROGRAMS

4.1 Water Levels

The forebay water level at Seven Sisters is measured and recorded using a water level gauge located in the powerhouse. The gauge consists of a float with a steel tape draped over a pulley on a motor which drives an electronic device in the control room. This device accepts the output of the motor, displays the water level elevation directly to the station operators, and outputs a signal to the Remote Terminal Unit (RTU) for transmission to the System Control Centre. System Control Centre staff monitor the water level data and respond to alarms as required. The water level data is also recorded on Daily Hydraulic Reports that are forwarded to the Operating Supervisor. The report is reviewed, signed and sent to the Hydraulic Operations Department. The Hydraulic Operations Department staff enters the data into a hydrometric database that is accessible to interested parties within Manitoba Hydro.

The station operators at Seven Sisters calibrate the forebay gauge manually once a week (repetitive work order) or as required, such as prior to Uniform Rating of Generating Equipment (URGE) testing. The calibration is performed by comparing the manual reading to the electronic meter in the control room.

Manitoba Hydro prepares an annual report documenting water levels and flows within Water Power Act licence areas. The report contains analysis of water level and flow data related to the licence conditions for the calendar year. Information specific to Seven Sisters includes the analysis of forebay level data, maps, photos, project description, and gauge and data collection description. In addition to the annual report, Manitoba Hydro performs weekly licence compliance checks for all Water Power Act licence conditions. Manitoba Hydro reports licence limit exceedances to Manitoba Water Stewardship upon occurrence.

4.2 Dam Safety

Manitoba Hydro's Dam Safety Program is based on the Canadian Dam Association Guidelines. Both concrete and earth structures continue to be inspected at regular intervals for any anomalies or deficiencies. Routine inspections by Manitoba Hydro staff are performed twice per month for the earth structures and bi-monthly for the concrete structures, including the spillway. Additional inspections of all water retaining structures are performed by specialists from Manitoba Hydro's Engineering Services Division annually. Klohn-Crippen performed a Dam Safety Review (DSR) inspection of all the primary structures in 1998. Manitoba Hydro has completed a significant amount of work addressing the concerns raised in this DSR. Manitoba Hydro completed a review in 2004 to ensure that appropriate repairs and maintenance continue to be performed. As part of the Water Power Act licence renewal process, we will be providing a condition assessment report of the generating station and its associated structures.

4.3 Aquatic Monitoring

Healthy fish populations exist above and below the Seven Sisters Generating Station. Recent work by Canadian Rivers Institute (Dr. Stephen Peake and his graduate students) has documented the fish populations in the area with special focus on the biology and life history of lake sturgeon. A key result of those studies is that there are healthy sturgeon populations above the generating station and habitat that is used for spawning in the tailwater.

System wide monitoring of aquatic ecosystem health including water quality, lower trophic levels and fish sampling is taking place upstream and downstream of Seven Sisters Generating Station under the Coordinated Aquatic Monitoring Pilot Program (CAMPP); a program of activities by which the Government of Manitoba and Manitoba Hydro are working together to provide objective information about hydrometric and environmental effects of hydro-electric development. Upstream sampling is currently occurring in the Pointe du Bois area along with sampling in Lac du Bonnet, downstream of the station. This work is intended to monitor aquatic ecosystem health on the Winnipeg River into the foreseeable future.

5.0 SYSTEM UPGRADES/STUDIES AND AGREEMENTS

5.1 System Upgrades/Studies

Manitoba Hydro undertook significant rehabilitation of the Seven Sisters Generating Station between 1979 and 1983, including building a new north non-overflow dam, concrete repairs to the north, south and centre sluiceway piers as

well as several spillway piers and rollways. The original concrete was low-strength concrete and did not have adequate durability. Exposed portions began to deteriorate shortly after construction, which led to annual repairs. Investigations to evaluate the condition of the concrete structures occurred from 1975 to 1978. The rehabilitation efforts were based on the recommendations from these investigation reports.

The structural stability of the spillway, sluiceway and south non-overflow dam was improved by installing anchors in 1994.

Major dyke upgrades occurred in 1980 and included placement of quarried rock on the north and south dykes to improve upstream slope protection, as well as the placement of granular fill to upgrade the crest and repair areas of settlement. Remedial work has also included construction of stabilizing berms at the downstream toe of the dykes and topping up of the dykes.

A 2008 report, completed by the Engineering Services Division, on updated freeboard analyses for the Winnipeg River generating stations indicated that freeboard deficiencies exist at Seven Sisters for extreme wind conditions. A further study was completed in 2009 to determine what steps are required to address these freeboard issues. Results will be forthcoming.

Units 1 to 4 were refurbished between 1992 and 1998 with increased capacity to 42,000 horsepower (Unit 1, 1993), 41,260 horsepower (Unit 2, 1992), 40,900 horsepower (Unit 3, 1994) and 43,000 horsepower (Unit 4, 1998).

5.2 Agreements

Since the 1950's, agreements have been reached with private land interests in which the effects of hydraulic operations on subject lands are addressed.

6.0 CLOSURE STATEMENT

Manitoba Hydro continues to operate the Seven Sisters Generating Station in accordance with the Final Licence for the Development of Water Power at the Seven Sisters Falls Site on the Winnipeg River. Manitoba Hydro operates and maintains the generating station and associated structures based on the Canadian Dam Association Guidelines.

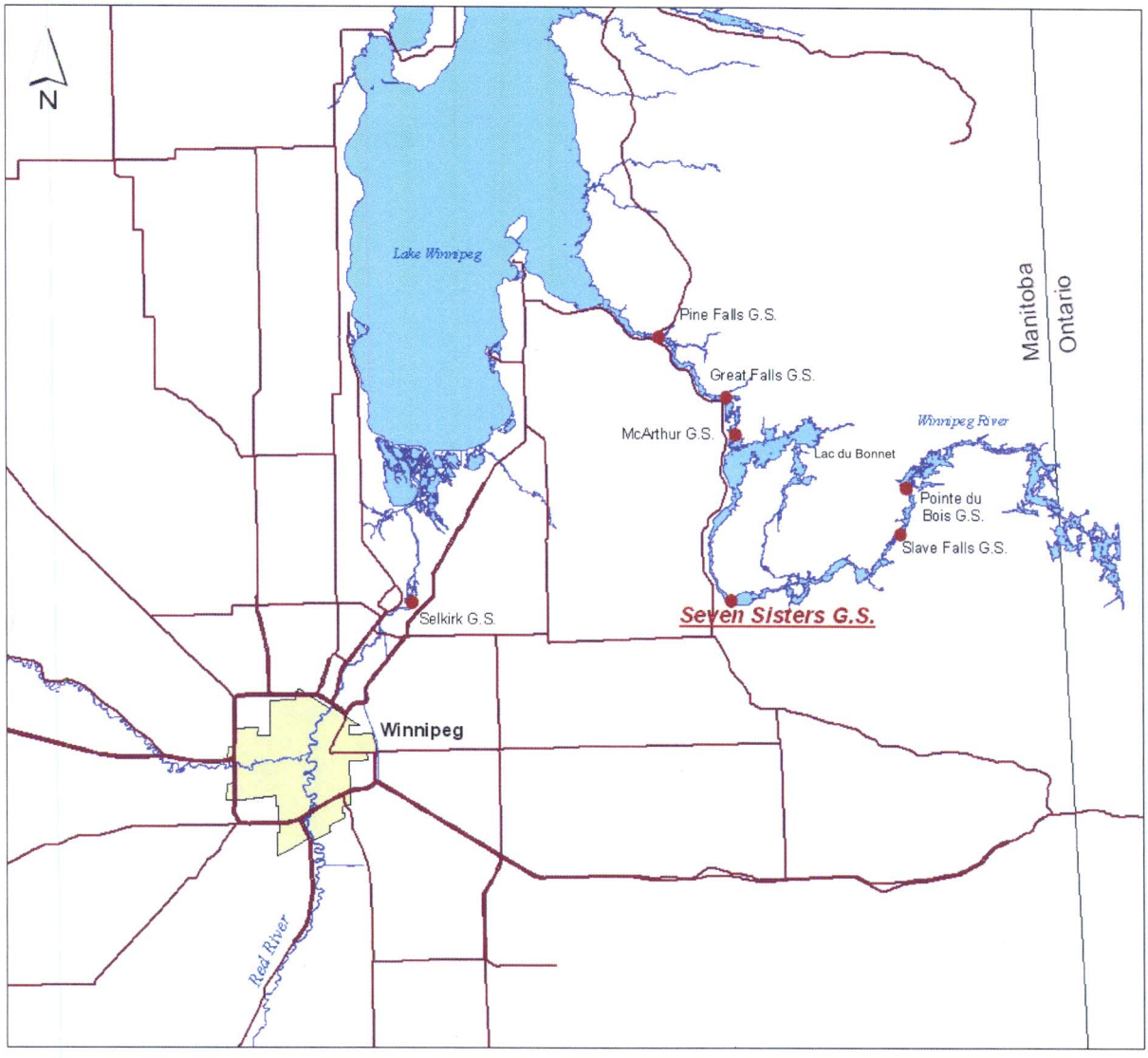


Figure 1: Seven Sisters General Location

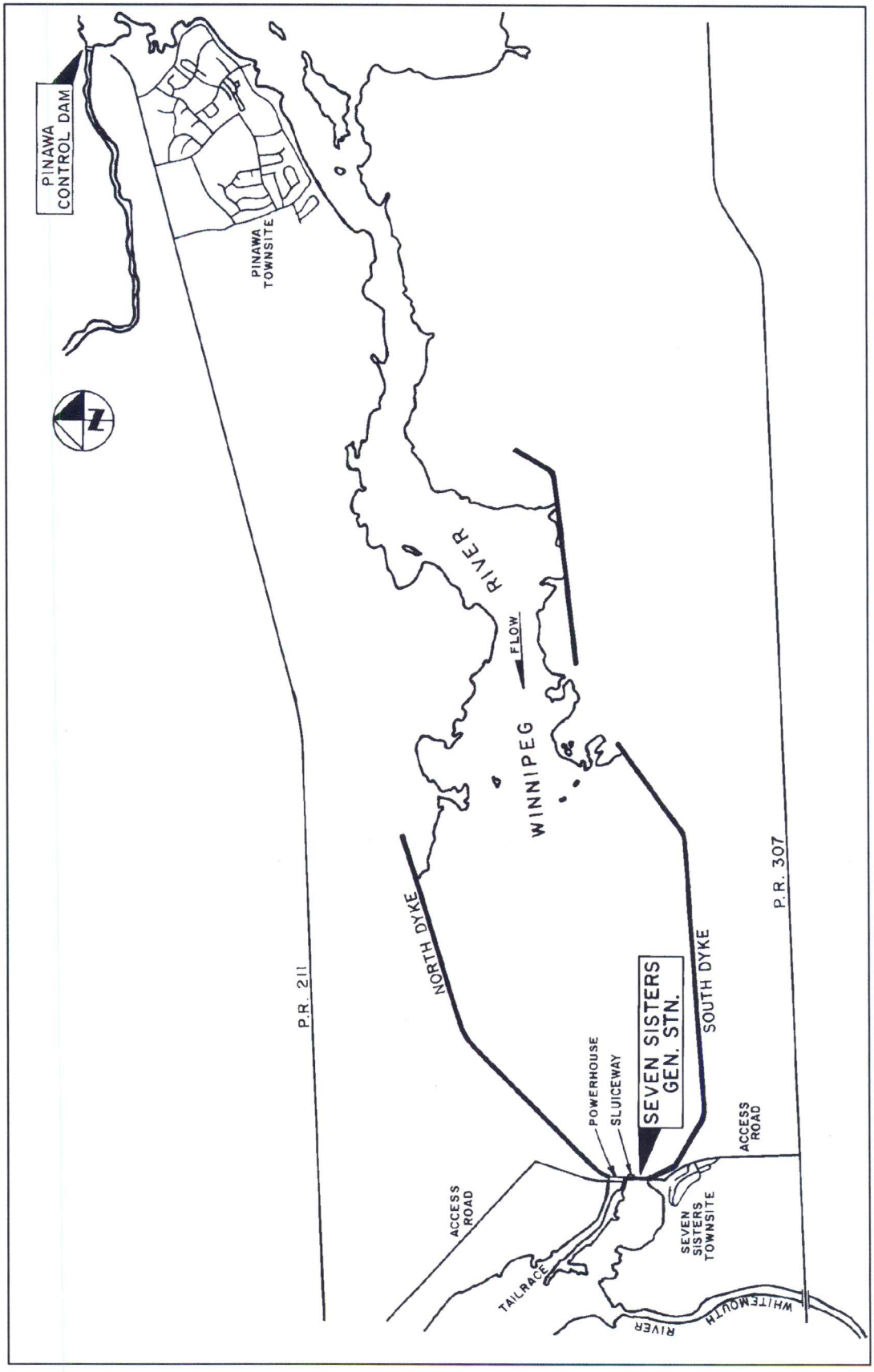


Figure 2: Seven Sisters Overall Site Map

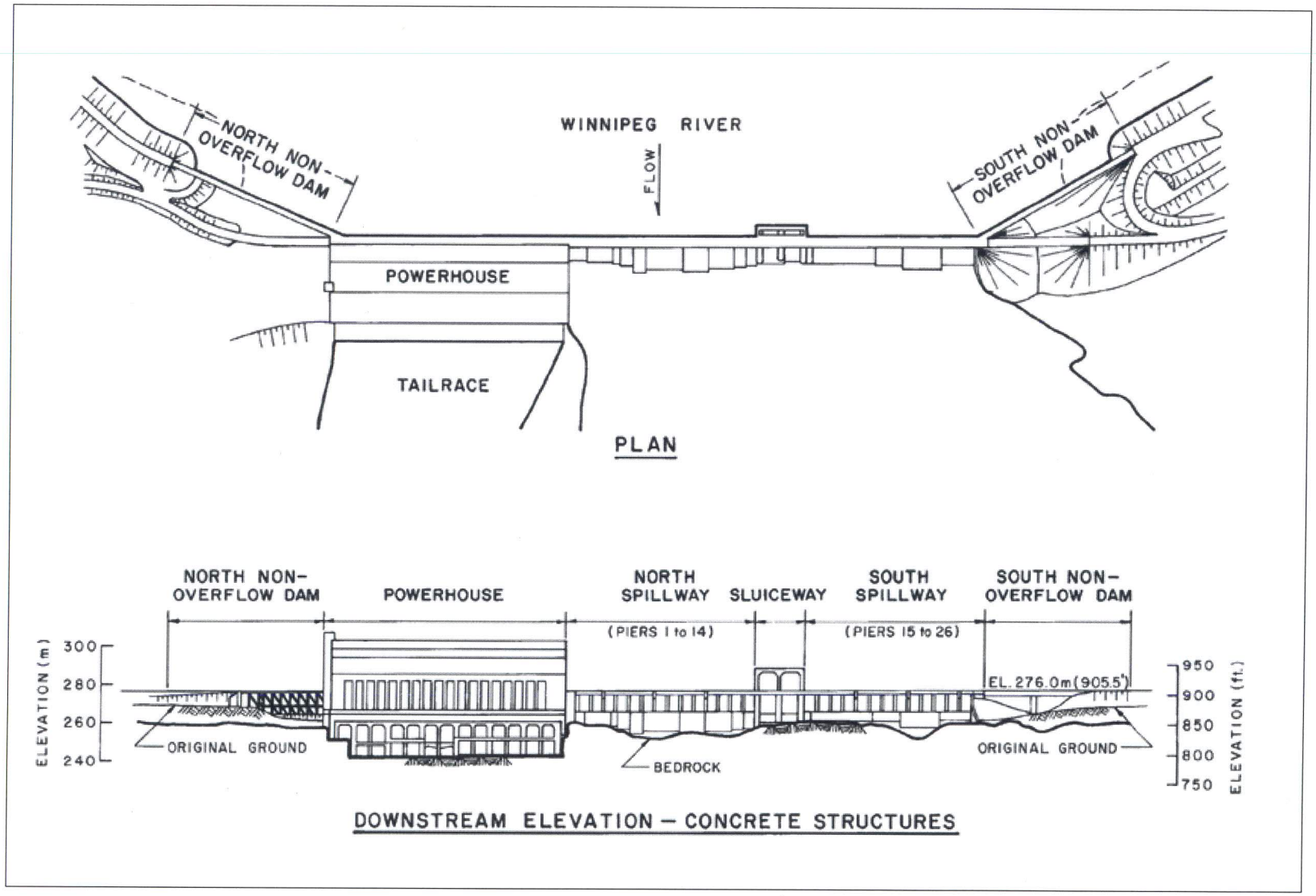


Figure 3: Concrete Structures - Plan and Elevation

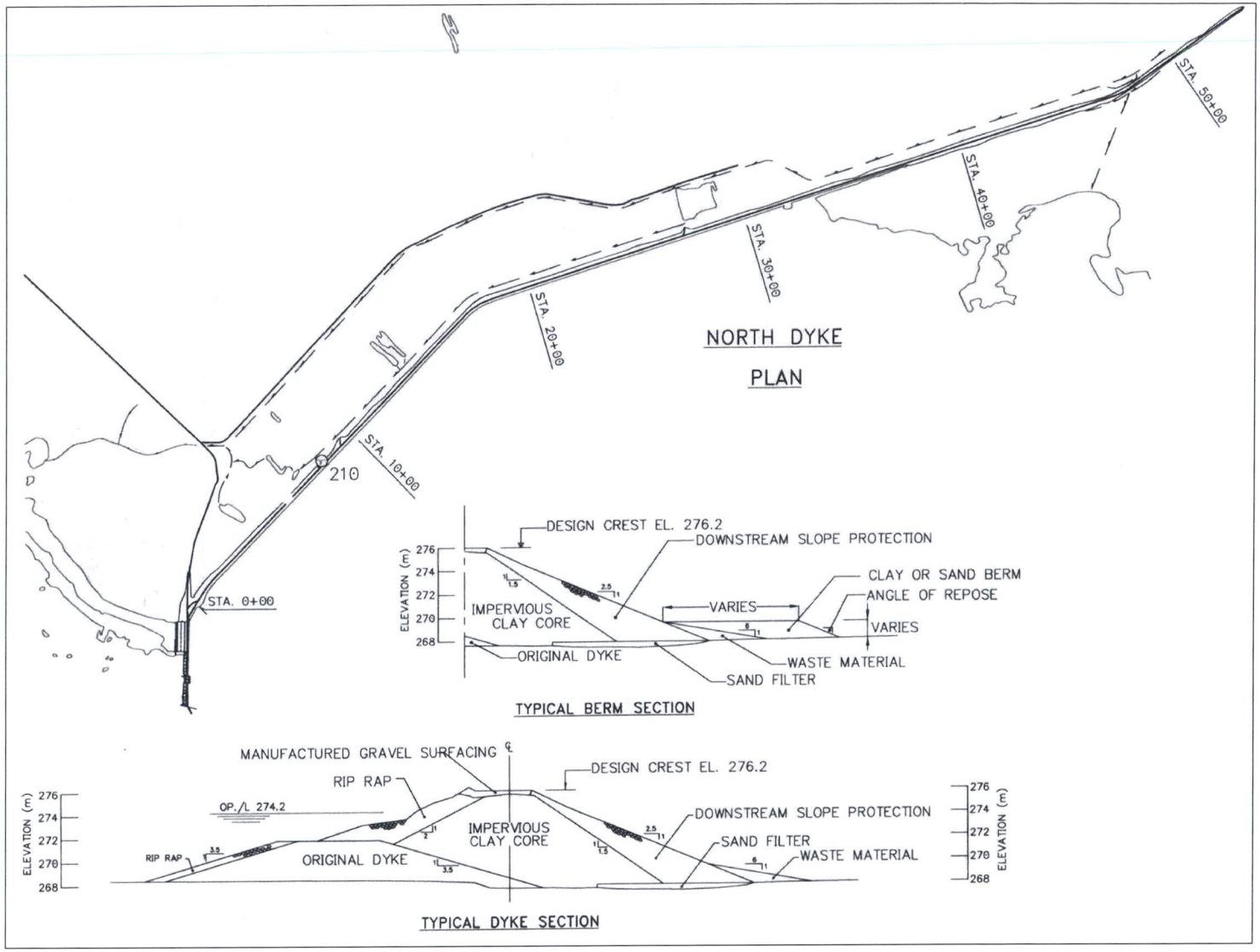


Figure 4: North Dyke - Plan and Typical Sections

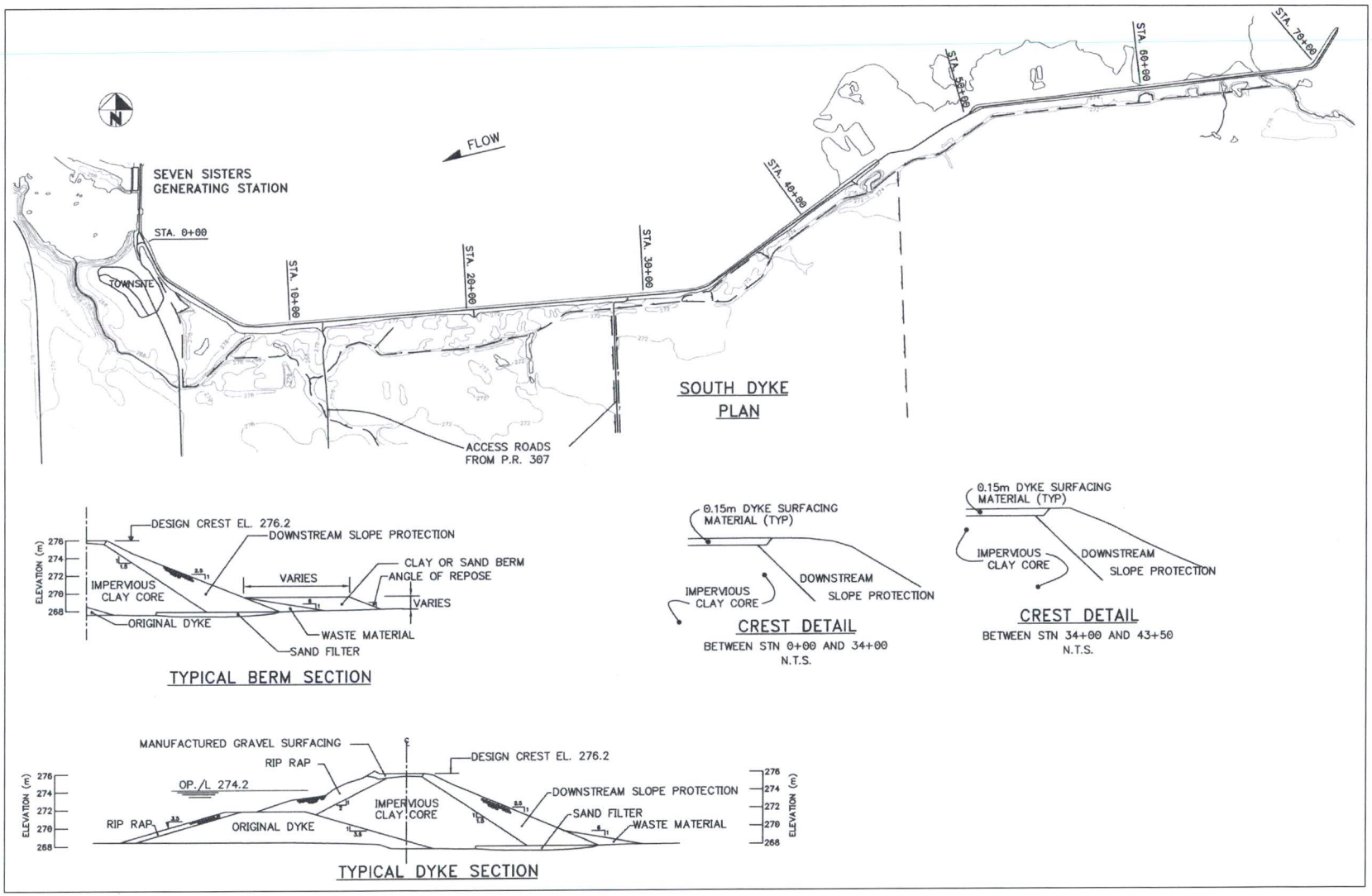
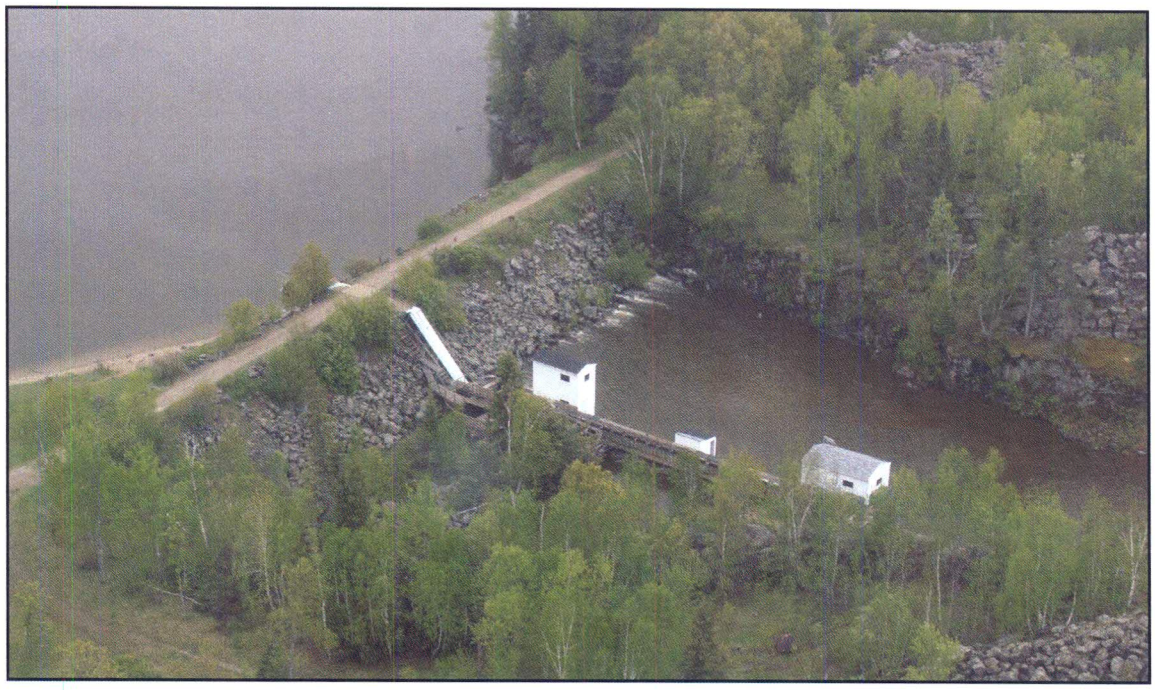


Figure 5: South Dyke - Plan and Typical Sections

Photograph 1: Seven Sisters Generating Station



Photograph 2: Pinawa Control Dam